

ACCESS GRID HARDWARE SPECIFICATION

Robert Olson
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Overview

An Access Grid node is defined as a specific ensemble of hardware and software. This definition enables the software to make certain assumptions about the environment in which it is executing. It also provides the community with a common experience, and resulting common body of knowledge.

The hardware components of an AG node fall into three broad categories. *Computing* equipment includes the four computers that drive the node and the associated adapter cards, network hardware, monitors, keyboards, and so on. *Media* equipment includes the audio processing hardware, microphones, speakers, video cameras, etc. *Projection* equipment includes the projectors for the display, mounting hardware, screen materials, and so on.

There are some parts of this specification that can vary from site to site. Specific brands of computers or microphones do not necessarily make an impact on the performance of the node (however, we have heard of particular brands that do not work, and we have experience with brands that work very well). We will flag both those components that can be substituted and those that cannot. When in doubt, call or email us with your questions and we can let you know of our experience or lack of it with a given piece of equipment.

The only variation between general node configurations is in the number of microphones that need to be supported and the number of projectors used in the node. We lay out a “small node” and “large node” configuration for the audio hardware. Projector layout is largely affected by room design.

The prices in the tables in this document are for estimation purposes only.

Computing Equipment

An AG node is driven by four computers. We typically recommend that sites purchase the fastest commodity PC that fits within their budget. The machine’s ability to operate properly with the multiple display adapters in the display machine, and with the multiple video capture adapters in the video capture machine is more important than the raw CPU speed.

Each computer requires a 100 Mbit Fast Ethernet adapter. We have had good luck with the Intel EtherExpress Pro/100 cards.

Each computer should have at least 256MB of RAM and 9G disk space. We recommend purchasing memory in a way that it can be upgraded at a later date (a single 256MB DIMM instead of 2 128MB DIMMs, for instance).

One can attach a keyboard, mouse, and monitor to each computer. However, to save space we typically install a dual-console KVM switch to allow control of two of the machines at once from a pair of monitor stations.

The Appendix contains the SAG customizations for the prices quoted below. These prices are for rackmount server PCs. We have found that rack mounting as much of the AG node equipment as possible makes it possible to reduce the size, clutter, and noise of the equipment.

Display Computer

The display computer is configured with a Matrox G400 Dual Head AGP graphics adapter and a Matrox G200 Quad PCI graphics adapter. This combination allows the system to drive up to six displays. Check with your vendor to ensure that this combination of cards will operate correctly in the system – we have seen some where it does not.

The display computer should be a dual-processor machine, since it shoulders the load of software video decoding and running any applications on the display. This machine runs Microsoft Windows 2000 Professional, and should also have Microsoft Office 2000 Professional installed.

We typically also configure the display computer with a ZIP drive and PC card reader to more easily support presenters who may have presentations on ZIP or flash card media.

Table 1. Display computer configuration.

PC, 2-processor SMP 550MHz or more	\$3,400
Matrox G400 Dual Head AGP Graphics Adapter	\$200
Matrox G200 Quad PCI Graphics Adapter	\$700
Total	\$4,300

Video Capture Computer

The display computer should also be a dual-processor SMP computer, as it is responsible for the software compression of multiple video streams. We use four Hauppauge WinTV/PCI video capture cards for the capture. Ensure that the computer you use has enough PCI slots for the capture cards and for a fast Ethernet adapter if necessary.

There are several models of the Hauppauge cards available. We typically use the model 401 which includes an S-Video input. The product lineup is available at <http://www.hauppauge.com/html/products.htm>.

The video capture computer runs Red Hat Linux.

Table 2. Video capture computer configuration.

PC, 2-processor SMP 550MHz or more	\$2,600
Hauppauge video capture adapters	4 @ \$98
Total	\$2,992

Audio Capture Computer

The audio capture computer is currently only required to be a single-processor computer, but for possible future use it would be prudent to purchase a dual-processor or dual-processor-capable computer.

We specify three audio capture cards in anticipation of future software advances that will allow the use of the multiple audio channels. We have had good luck with the Creative SB128 series of cards. The model of card is a particular concern, in that we require Linux drivers for the card. The drivers we currently use are provided by 4Front Technologies, and are not a free product. However, the license fee is quite reasonable. A demonstration version of the drivers is included in the AG Linux distribution, and can be activated with a license ordered from 4Front.

A future engineering goal of the AG project is to make use of the open source ALSA drivers. They are not quite stable enough for our use yet, but we would like to encourage people to purchase hardware that is supported by these

drivers. The issue here is that some vendors do not release enough programming information for open-source software developers to write drivers. The ALSA driver compatibility information is available from the ALSA homepage at <http://www.alsa-project.org>.

Table 3. Audio capture computer configuration.

PC, 550MHz or more	\$2,362
Creative SB128 Audio Adapter	3 @ \$100
Opensound license for AudioPCI	\$30
Total	\$2,692

Control Computer

The audio capture computer is currently only required to be a single-processor computer, but for possible future use it would be prudent to purchase a dual-processor or dual-processor-capable computer.

The current purpose of the control computer is to run the control software for the Gentner echo cancellation hardware. In the future we plan to greatly expand the role of this computer.

This machine currently runs Microsoft Windows 98. The Gentner software will not run correctly on Windows 2000.

Table 4. Control computer configuration.

PC, 550MHz or more	\$2,417
Total	\$2,417

Other Computing Hardware

We have found it is useful to have an intelligent network switch dedicated to an AG node. We have been evaluating several Fast Ethernet switches with Gigabit Ethernet uplinks. The Intel 460T and Extreme Networks Summit both appear to be good choices for this use.

Keyboard/video/mouse switching was mentioned earlier in this specification. We are pleased with the Belkin OmniView Matrix switch, which is a 2 console, 8 computer switch.

Table 5. Other computing hardware.

Intel Express 460T, 16 ports	http://www.intel.com/network/products/exp460t.htm	\$750
1000BaseT uplink module		\$480
Extreme Networks Summit24	http://www.extremenetworks.com/products/datasheets/summit24.asp	
Belkin OmniView Matrix	http://catalog.belkin.com/IWCatProductPage.process?Merchant_Id=1&Product_Id=13015	\$1000
17" Monitor		2 @ \$400

Media Equipment

The media equipment used in an AG node includes video cameras, microphones, and other associated hardware.

Echo Cancellation

The most important part of the media setup is the echo cancellation hardware. We require the use of either a Gentner AP400 or Gentner AP800 echo canceller. Which product is used is dependent on the size and purpose of the space being configured. The AP400 can serve a maximum of four microphones, the AP800 a maximum of eight. If more microphones are required, multiple AP400 or AP800 devices can be chained together using the proprietary Gentner digital bus. If an AP800 is used, a Gentner AP10 telephone interface device will also be required for telephone bridging. A telephone bridge is included in the AP400.

In deciding whether to buy an AP400 or AP800+AP10, please keep in mind that all microphones must attach directly to the Gentner inputs. In order for the Gentner to correctly cancel each audio signal, the different microphones cannot first be combined with a mixer.

Microphones

We have had the most success with Crown PCC-160 desktop microphones. There should be enough of these in the space so that any participant is within 2-5 feet of a microphone.

We have experimented with the Audio-Technica AT853a hanging microphone as well. These may be appropriate for rooms with no tables on which to place microphones.

Vega wireless microphones also work very well.

Cameras

We currently recommend the use of remote controlled pan/tilt cameras. We have had very good luck with the Sony EVI-D30 and Canon VC-C3 cameras. Each has a serial interface with which it can be computer controlled. They are also controllable via remote control, and multiple cameras in the same space can be assigned unique device ids.

Miscellaneous

We highly recommend the use of a power conditioner for all audio equipment.

We also require the use of a level balancing device between the Audio Capture machine and the Gentner. This does two things: converts between balanced and unbalanced wiring, and adjusts the voltage level of the audio signal. (The PC and Gentner have different audio voltage references). We recommend the ATI MatchMaker MM100.

Table 6. Small node audio configuration

Gentner AP400	http://www.gentner.com/t4pap4.html	\$4,000
Crown PCC-160 microphone	http://www.crownaudio.com/crownaudio/mic_hm/pcc.htm#3	4 @ \$260
Genelec Near-range Monitor	http://www.genelec.com/1029a.htm	2 @ \$535
ATI Matchmaker MM100	http://www.markertek.com/MTStore/product.CFM?BaseItem=MM100	\$299
Furman PL8	http://www.markertek.com/MTStore/product.CFM?BaseItem=PL%2D8	\$115
	Total	\$6524

Table 7. Large node audio configuration

Gentner AP800	http://www.gentner.com/t4pap8.html	\$5,000
Gentner AP10	http://www.gentner.com/t4pap1.html	\$800
Crown PCC-160 microphone	http://www.crownaudio.com/crownaudio/mic_htm/pcc.htm#3	7 @ \$260
Vega T25 wireless transmitter		\$460
Vega R22 wireless receiver		\$750
Countryman headset microphone MHHW5HH05-VS		\$250
Genelec Near-range Monitor	http://www.genelec.com/1029a.htm	2 @ \$535
ATI Matchmaker MM100	http://www.markertek.com/MTStore/product.CFM?BaseItem=MM100	\$299
Furman PL8	http://www.markertek.com/MTStore/product.CFM?BaseItem=PL%2D8	\$115
Total		\$10,564

Table 8. Video camera options.

Sony EVI-D30	http://www.picturephone.com/fp_sony3.htm	4 @ \$1,299
Canon VC-C3	http://www.usa.canon.com/corpooffice/viscommq/vcc3.html	4 @ \$1,039

Projection Equipment

The display in an Access Grid node should include at least three projectors. We find that there is not enough usable screen real estate for useful collaboration with less than that.

Depending on the layout of the room, one can choose a front projection or rear projection solution. Front projection is easier to install, as screen material can be applied directly to an existing wall. Rear projection requires more space for the projector throw behind the translucent screen.

We have been happy with the WallTalker screen material. This is a vinyl screen material that can also be used as an erasable whiteboard. It is applied like wallpaper.

Projectors for the AG must have at least 1024x768 pixel resolution. Digital keystone adjustment is not useful in a multiprojector tiled display, as pixels are lost in the adjustment process.

Table 9. Projection equipment.

Epson 710c	http://support.epson.com/hardware/projector/pl710c/index.html	3 @ \$5,300
Walltalker NuVuRite	http://www.walltalkers.com/prodinfo.htm	\$25 / linear foot

Price Summaries

Following are sample price summaries for a large and a small node. We assume two monitors and a KVM switch, and a single 100Mbit uplink.

Not included are cabling costs, or projector and camera mounting costs.

Table 10. Pricing summary for small node configuration.

Computing equipment	\$12,455
Network equipment	\$750
Other computing equipment (monitors, KVM switch)	\$1,800
Small node audio configuration	\$6,524
Video cameras (4 Sony EVI-D30)	\$5,196
Projectors (3 Epson 710c)	\$15,900
Total	\$42,625

Table 11. Pricing summary for large node configuration.

Computing equipment	\$12,455
Network equipment	\$750
Other computing equipment (monitors, KVM switch)	\$1,800
Large node audio configuration	\$10,564
Video cameras (4 Sony EVI-D30)	\$5,196
Projectors (3 Epson 710c)	\$15,900
Total	\$46,665